IMCC/MSHA/OSM Benchmarking Workshop on Underground Mine Mapping
October 15 and 16, 2003
The Galt House Hotel
Louisville, KY

NOTE: On Day Two of the Benchmarking Workshop, attendees participated in an interactive discussion of several topics that were introduced by a panel of presenters during four roundtable sessions. The following notes reflect some of the discussions that took place during those sessions.

Roundtable Session I: Acquiring and Preserving Map Images

Presentation by PA Bureau of Deep Mine Safety

They scan at 300 DPI in color and save to TIFF
They use a Vidar Color Scanner
It preserves details on the map
The intention is to preserve and scan the maps as a visual equivalent of the original

Presentation by Virginia Department of Mines, Minerals and Energy

Scans in color at 200 to 300 DPI depending on the level of detail in document
Save as TIFF 6 format for Archive
Compress as Mr. SID for daily use
Anyone can view Mr. SID files with free SID viewer
They have a portable scan station that they can take to remote locations for scanning maps. This is essential to their acquisition of many maps because many people won't let maps off site.
They use a Color Track 5400 scanner that takes maps up to 12mm thick.
Georeference using AutoCAD Map

Presentation by OSM regarding OSM Mine Map Repository

Repository began scanning 5 to 6 years ago
Started at 100 DPI, then 200 and now 400 DPI
Just purchased a new 54 inch scanner and will scan all original maps that come in. Will not abandon the aperture card process.

Several questions were raised by the moderator prior to an extended period of discussion, as follows:

Of the 20 states represented at the workshop:
How many states have capability to scan   Answer. 12
How many states have laws in place that require submission of
mine maps   Answer: 10 (coal)
                                                                     4 (noncoal)

How many states receive signed and certified coal mine maps   Answer 9
How many receive signed and certified non coal maps   Answer 4
How many states require final non-certified coal maps   Answer 2
How many states required to keep and preserve maps   Answer 9
How many states required to keep maps in secure location   Answer 4 or 5
How many accept electronic mine maps   Answer 9

MSHA requires submittal of final coal mine closure map for all mines. Some district offices send these to OSM and others do not.
Some companies go out of business before closure and maps are not submitted.
MSHA has no map submittal requirement for non-coal mines.
While OSM has a mutual agreement with some MSHA district offices to receive closure maps, this is not a requirement of MSHA and not all districts do it.

West Virginia started last fall acquiring mine maps
Effort includes talking to many groups and organizations including:
- Coal associations
- Engineering and survey firms
- Professional Engineering Board
- Survey Board

Effort includes:
- Acquiring maps of old mines
- Editing database and comparing it with the OSM database
- Taking a fresh look at map requirements for active mines, talking to operators about electronic submittal, getting information for all active mines
- Getting final maps of all current mines by providing resources to mine companies such as a checklist of information to be included on final map (georeferencing info required).

MSHA asked how states get companies to release maps.

WV stated that persistence prevails. They have continued to work with operators on issues like liability and confidentiality. Some companies are developing disclaimers to deal with liability.

Virginia has been successful by just persisting. Also, VA gives the company something back by making scanned mine map and database information available to mining companies for new permits and other actions. VA puts a disclaimer on all data released.

Illinois said that they have had great success with some companies and less with others. IL gives electronic copies of all scanned maps back to the mining company. IL suggested that all states send copies of scanned maps to the OSM MMR as an archive or national storehouse. 17 states replied that they would do this if asked by OSM.

North Carolina said that we need a document maintenance plan for electronic data.

IL stated that the national MMR must have a data upgrade plan or data will become obsolete.

It was asked how many states have a quality controlled facility to store and preserve paper maps long term. Seven states responded that they do have one. It was also asked how many states have facilities to store maps properly (i.e. flat and climate controlled). The answer was four.

We learned that OSM MMR does not keep original paper maps. They are microfilmed and/or scanned and returned to sender.

Wyoming uses state archives to store paper maps. IL has a dedicated mine map storage facility. Others states are able to work their state archivists as well. In fact, ten states indicated that they have state archive facilities or agencies that can store maps.

PA stated that the compact disk is not an appropriate long term data storage medium. It was suggested that people use a redundant server for this process.
Illinois stated that we may need Federal requirements for final mine maps on non-coal mines, similar to those for coal mines.

IL also said that we need a MSHA requirement that all district offices send final closure maps to OSM-MMR.

BLM stated that we need a statute requiring submittal of all final mine maps.

OK stated that we should scan every unique map, not just the latest map for a mine. Early maps and operation plan maps may contain a lot of detail that the final map may omit. We especially need to capture surface features.

New Mexico wants a database of all company lineages to find out who has the old maps. New Mexico has not scanned any mine maps yet.

Ohio stated that they would like to see a general list of sites where people would look for mine maps.

MSHA stated that the Library of Congress has a mine map collection. Also has maps by state. This collection is called the Sanborn Collection and is available via the web.

Someone suggested that paper maps are the only acceptable Archive medium right now.

Other issues/topics that were raised during this session included the following:

- Deterioration of maps: how do we protect maps and bring them forward into the future?
- What should we scan – the original or a copy?

- Quality control is critical, especially in terms of protection and storage.
- We need scanning solutions
- Cataloguing and indexing is also critical
- We should focus more resources on georeferencing and rectification
- How do we define what a "final" map is and what we do with it?
- Liability concerns: how do we get companies (both land and mining) to release maps? Issues here include: proprietary information; potential legal liability; use of disclaimers; sharing information back with the companies; and use of the information we receive as a "footprint", not a "hammer".
- Potential use of OSM's national mine map repository for all maps (digital copies)
- Storage of original maps – use of state archivist agencies here.
- Storage – CD (digital) v. original paper copies of maps
- Standards for submittal of maps for active coal and noncoal mines
- Importance of capturing unique map characteristics, usually on oldest available maps.
- Resource for contacting mining companies who mined in the past
- Guidelines for what states are attempting to capture in their mapping efforts.

Roundtable Session II: Moving Maps to GIS

Kentucky – they reprocess the file to best fit 32 colors. It was stated that KY started scanning maps 6 months ago. Started at 200 DPI, 24 bit color, then reprocess to 32 color 8 bit data. They use MS Photoshop with Active X to automatically reprocess image files overnight. Have an ACAD utility they build in-house for semi-automatically georeferencing. They enter 2 points then enter or point and click to set the scale. Then you pick other points with a snap to grid feature.

West Virginia - has a rough set of guidelines for georeferencing. They use the following features, in order, as tie points for maps:
- Standard coordinates
- Geologic features
- Mine features
- Railroads
- Oil and gas wells
- Transmission lines
- Roads
- Property lines
- Streams

WV has other guidelines including:
- Don't do anything that distorts the mine features
- Estimate average positional error at 10 meters
- Use GIS as index to detailed mine maps, but do not actually display the mine maps in the GIS for public.
- Comply with FGDC metadata rules

Illinois made several suggestions. Scan and save all maps as uncompressed TIFF for archive purposes. You can then compress the images for use in GIS or other. Never fold maps during scanning. Cut and splice if necessary. Never rubbersheet maps.

MSHA asked which states have state funding for mine map efforts. Answer: 3
How many rely solely on Fed funds – Answer: 6
How many have no funding specifically earmarked to do anything on mine maps.
Answer: 7. Of these, six state are not doing any mapping; one state is doing mapping.

It was also asked how many states require a geo-referenced coordinate system for their mine mapping effort? Answer: 8.

Indiana suggested that map collection efforts be sensitive to user needs and comments.

Illinois asks companies to place permanent markers at all shafts and record the location with the courthouse. This is not by statute but simply by request. IL asked if other states do it. The answer was no.

Someone stated that today's mine maps do not contain the details that old maps had.

Someone suggested national guidance on:
> Organizing maps
> Indexing maps
> Managing maps
> Software
> Hardware
> Data management

Someone suggested we need a coordinated effort to compile a standard model and examples of a GIS.

Someone also suggested that OSM needs to discuss setting up a web site or message board for tech transfer on mine maps, possibly a list server.

Other topics/issues raised during this session included the following:

- Georeferencing is an art form
- Digitizing makes it easier to use data
- Capturing and attributing information
- Image processing – minimize user intervention
- Data validity – source document impact on uncertainty and error
- Importance of funding/resources to make sure of newer technologies for georeferencing and digitizing

- GIS can serve an index to more detailed mine maps
- Database management and indexing: potential data model and/or guidance; mechanism to share this information.

NOTE: At this point in the proceedings, several states who did not make formal presentations on Day One were invited to provide an overview of what is occurring in their respective state regarding mine mapping efforts. Among the presentations were the following:

Kansas -- Ken Nelson with Kansas Geological Survey stated that KS has just started moving mine maps to GIS. Has a scanner available and lots of computing hardware. Uses ArcSDE for other GIS data. He lacks money for staff to do mine map georeferencing.

Missouri -- Cheryl Seeger said Missouri Geological Survey has made no concerted effort to find mine maps or move to GIS. They have a large color scanner but no staff time. The maps that they do have are stored flat.

Iowa -- Mary Howes stated that Iowa has an inventory of 1600 to 1700 mine maps, most are prior to 1940. During the 1980's Iowa used $30,000 from the AML program to have the state Achiever wash the maps to remove acids and seal them in Mylar envelopes. The maps are stored flat. They used AutoCAD to digitize mine boundaries from the maps. Also photographed all maps in 81/2 by 11 inch and use these photos for day-to-day work. Today, Iowa has a GIS with mine data stored in it and maps for 830 mine sites. They know of 2000 mines that may have existed in the state and need to identify and verify the locations of each. Iowa is just in the beginning of creating an ARC IMS site.

New Mexico -- Alysia Leavitt of New Mexico reported that NM has 10,000 to 15,000 abandoned UG mines. They have one room full of mine maps. The only scanning that is done is the Open File maps and this is a minimal number. Their next step is to index the maps they have. At this time, they do not use TIPS for anything related to mine map efforts.

Oklahoma -- Mary Ann Prichard and Mike Sharp reported that the Oklahoma Department of Mines has a vault of underground mine maps. Only a few are scanned. The AML program staff retrieves the ones they need on an as-needed basis. They have 1500 to 2000 coal maps and 500 lead/zinc maps. They report that Missouri Southern College in Joplin, Missouri has the old Bureau of Mines map collection for the Tri-State district. The Missouri maps are on microfich. Oklahoma and Kansas are on paper and linen. They know that there were about 100,000 drill holes in the Tri-State area but they have only about 14,000 drill logs at Missouri Southern.

Overviews were also presented by NY, WY and CO but were not transcribed and are unavailable.

Roundtable Session III: Access/Sharing Information

A key element here is: who is your customer base? It can include the mining industry; insurance companies; landowners; the general public; planners (county, city, etc); state agencies (i.e. the departments of transportation); utilities; consulting firms; lenders; and the news media.
The use of websites is becoming more useful and practical.

Someone suggested the use of a subscriber service.

A key issue is how the information will be used – there are different views and needs

Importance of sharing freely validated data.

Roundtable Session IV: Next Steps – Moving into the Future

This session began with an overview from MSHA and OSM about their respective visions for the future, including potential sources of funding for state mine map initiatives.

MSHA stated that out of the $10 million, no-year money that it received from Congress as a follow-up to the Quecreek incident, $6 million has been earmarked for demonstration projects for detecting underground mine voids. An RFP was issued and responses are due by November 1. Another $4 million has been specifically earmarked for digitizing of mine maps. This money is specifically designated for state grants and grant proposals are open to the entire mapping effort. At this juncture, MSHA is considering distributing the money in three increments over three years: $2 million by 12/1/03; another $1 million by 10/1/04; and the final $1 million by 10/1 05. However, the agency may re-think their position on this and choose to make all $4 million available immediately, depending on the nature of the state grant proposals. States were encouraged to submit their proposals to MSHA no later than November 1. For further information, states were directed to contact Larry Checca with MSHA at checca.elio@dol.gov.

OSM stated that it is hoping to include an amount of money (yet to be determined) in its budget for FY 2005 to enhance its mine map repository but also to develop and enhance "centers of excellence" at the state level that will allow states with advanced experience and information on mine mapping to share their expertise with other states. OSM would also like to see funding available to allow those states with larger workloads related to underground mine mapping to continue their on-going work and to bring all states up to some base level of performance. OSM views their initiative as a multi-year funding effort. It will be primarily focused on coal only, since SMCRA does not address noncoal. As part of its analysis of funding needs, OSM will be looking at hardware, software and training needs. For further information, contact John Craynon of OSM at jcraynon@osmre.gov .

Discussion then ensured regarding the types of next steps that might be appropriate as a follow up to this workshop. Beyond the individual state funding opportunities with MSHA and future state funding opportunities with OSM, it was recommended that several select working groups or committees be formed to refine and explore the following topics:

- Preserving and archiving maps (including storage and protection and a national effort to recover mine maps)
- Digitizing, scanning and ground-truthing maps
- Database management (including data validity; minimizing and quantifying error; cataloguing and indexing)
- Access and sharing information (including resolution of the liability issues)
- Future workshops or intergovernmental discussions (perhaps as a follow-up to the work of the working groups or committees)
- National guidelines (that might address mine map indexing, archiving, moving paper maps to CDs (digitization), etc.)
- Interactive web sites or a national mine map bulletin board
- Hazard prediction
- Coordinating the map acquisition effort, especially between OSM and MSHA
- Speed up the scanning of MMR maps
- Avoiding duplication between agencies, ideally through partnering
- Improve capabilities of all states to use and deliver maps, again through partnering
- Possible new, national regulations or guidelines addressing the preparation and submission of closure maps for all coal and non-coal mines.

Notes prepared by Len Meier of OSM and Greg Conrad, IMCC.